## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
### REQUEST FOR FILING NATIONAL PHASE OF
### PCT APPLICATION UNDER 35 U.S.C. 371 AND 37 CFR 1.494 OR 1.495

To:     Hon. Commissioner of Patents                  (
        Washington, D.C. 20231

TRANSMITTAL LETTER TO THE UNITED STATES          Atty Dkt:   **PM 274039**      /2980168US/LT/her
DESIGNATED/ELECTED OFFICE (DO/EO/US)                         M#      /Client Ref.

From:    Pillsbury Madison & Sutro LLP, IP Group:      Date:    November 21, 2000

This is a **REQUEST** for <u>FILING</u> a PCT/USA National Phase Application based on:

| 1. International Application | 2. International Filing Date | 3. Earliest Priority Date Claimed |
|---|---|---|
| PCT/FI99/00443 | 24 May 1999 | 25 May 1998 |
| ⇧ country code | Day MONTH Year | Day MONTH Year |
| | | (use item 2 if no earlier priority) |

4.  Measured from the earliest priority date in item 3, this PCT/USA National Phase Application Request is being filed within:

    (a) ☐ 20 months from above item 3 date     (b) ☒ 30 months from above item 3 date,

    (c) Therefore, the due date (<u>unextendable</u>) is   November 25, 2000

5.  Title of Invention <u>DETECTION OF INTERFERING SIGNAL IN RADIO RECEIVER</u>

6.  Inventor(s)    <u>HUTTUNEN, Mikko</u>

Applicant herewith submits the following under 35 U.S.C. 371 to effect filing:

7.  ☒ Please immediately start national examination procedures (35 U.S.C. 371 (f)).

8.  ☐ A copy of the International Application as filed (35 U.S.C. 371(c)(2)) is transmitted herewith (file if in English but, if in foreign language, file only if <u>not</u> transmitted to PTO by the International Bureau) including:

    a. ☐ Request;
    b. ☐ Abstract;
    c. ___ pgs. Spec. and Claims;
    d. ___ sheet(s) Drawing which are ☐ informal ☐ formal of size ☐ A4 ☐ 11"

9.  ☒ A copy of the International Application has been transmitted by the International Bureau.

10. A translation of the International Application into English (35 U.S.C. 371(c)(2))
    a.  ☒    is transmitted herewith including: (1) ☒ Request; (2) ☒ Abstract;
             (3)  9    pgs. Spec. and Claims;
             (4)  4    sheet(s) Drawing which are:
                       ☐ informal ☒ formal of size ☒ A4 ☐ 11"
    b.  ☐    is not required, as the application was filed in English.
    c.  ☐    is not herewith, but <u>will be filed when required</u> by the forthcoming PTO Missing Requirements Notice per Rule 494(c) if box 4(a) is X'd or Rule 495(c) if box 4(b) is X'd.
    d.  ☐    Translation verification attached (not required now).

11. ☒
   a. ☒    **PLEASE AMEND** the specification before its first line by inserting as a separate paragraph:
        --This application is the national phase of international application PCT/FI99/00443 _____
        filed _____ May 24, 1999 _____ which designated the U.S.--
   b. ☐    --This application also claims the benefit of U.S. Provisional Application No.
        60/___, filed ___.--

12. ☐    Amendments to the claims of the International Application **under PCT Article 19 (35 U.S.C. 371(c)(3)), i.e., before 18th month** from first priority date above in item 3, are transmitted herewith (file only if in English) including:

13. ☒    PCT Article 19 claim amendments (if any) have been transmitted by the International Bureau

14. ☐    Translation of the amendments to the claims **under PCT Article 19 (35 U.S.C. 371(c)(3)), i.e.,** of claim amendments made before 18th month, **is attached (required by 20th month from the date in item 3 if box 4(a) above is X'd, or 30th month if box 4(b) is X'd, or else amendments will be considered canceled).**

15. **A declaration of the inventor** (35 U.S.C. 371(c)(4))
   **a.** ☒   is submitted herewith    ☒ Original    ☐ Facsimile/Copy
   b. ☐   is not herewith, but will be filed when required by the forthcoming PTO Missing Requirements Notice per Rule 494(c) if box 4(a) is X'd or Rule 495(c) if box 4(b) is X'd.

16. **An International Search Report (ISR):**
   a. Was prepared by    ☐ European Patent Office    ☐ Japanese Patent Office    ☒ Other
   b. ☒   has been transmitted by the international Bureau to PTO.
   c. ☒   copy herewith (2 pg(s).).    ☒ plus Annex of family members (1 pg(s).).

17. **International Preliminary Examination Report (IPER):**
   a. ☒   has been transmitted (if this letter is filed after 28 months from date in item 3) in English by the International Bureau with Annexes (if any) in original language.
   b. ☒   copy herewith in English.
   c.1 ☒   IPER Annex(es) in original language ("Annexes" are amendments made to claims/spec/drawings during Examination) including attached amended:
   c.2 ☒   Specification/claim pages #8 & 9 claims # 1 - 8
        Dwg Sheets #
   d. ☐   Translation of Annex(es) to IPER   **(required by 30th month due date, or else annexed amendments will be considered canceled).**

18. **Information Disclosure Statement** including:
   a. ☒   Attached Form PTO-1449 listing documents
   b. ☒   Attached copies of documents listed on Form PTO-1449
   c. ☒   A concise explanation of relevance of ISR references is given in the ISR.

19. ☒    **Assignment** document and Cover Sheet for recording are attached. Please mail the recorded assignment document back to the person whose signature, name and address appear at the end of this letter.

20. ☐    Copy of Power to IA agent.

21. ☐    **Drawings** (complete only if 8d or 10a(4) not completed): _ sheet(s) per set: ☐ 1 set informal; ☐ Formal of size ☐ A4 ☐ 11"

22.   Small Entity Status ∅   ☒ **is Not** claimed    ☐ is claimed (**pre-filing confirmation required**)
22(a)   ___ (No.) Small Entity Statement(s) enclosed (since 9/8/00 Small Entity Statements(s) not essential to make claim)

23. **Priority** is hereby claimed under 35 U.S.C. 119/365 based on the priority claim and the certified copy, both filed in the International Application during the international stage based on the filing in (country) FINLAND of:

|     Application No. | Filing Date | | Application No. | Filing Date |
|---|---|---|---|---|
| (1) 981152 | May 25, 1998 | (2) | | |
| (3) | | (4) | | |
| (5) | | (6) | | |

   a. ☒   See Form PCT/IB/304 sent to US/DO with copy of priority documents. If copy has not been received, please proceed promptly to obtain same from the IB.
   b. ☐   Copy of Form PCT/IB/304 attached.

RE: USA National Filing of PCT/FI99/00443

24.    Attached: Copy of Form PCT/IB/306  & copy of Finnish OA

25.    **Preliminary Amendment:**    Claim 3, line 1, delete " or 2 "
                                       Claim  4, line 1, delete " 2 or 3, "
                                       Claim 7, line 1, delete " or  6 "
                                       Claim 8, line 1, delete " 6 or 7, "

25.5    Per Item 17.c2, **cancel original** pages #___, claims #___, Drawing Sheets #

26.    **Calculation of the U.S. National Fee (35 U.S.C. 371 (c)(1)) and other fees is as follows:**
Based on _amended_ claim(s) per above item(s) ☐ 12, ☐ 14, [X] 17, ☒ 25, ☐ 25.5 (hilite)

| | | | |
|---|---|---|---|
| Total Effective Claims | 8 | minus 20 = 0 | x $18/$9 = $0 | 966/967 |
| Independent Claims | 2 | minus 3 = 0 | x $80/$40 = $0 | 964/965 |
| If any proper (ignore improper) Multiple Dependent claim is present, | | add$270/$135 +0 | | 968/969 |

BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(4)): ➔➔ **BASIC FEE REQUIRED, NOW** ➔➔➔➔ ↓

A.    If country code letters in item 1 are **not** "US","BR","BB","TT","MX","IL","NZ", "IN" or "ZA"    ↓

       See item 16 re:
       1.    Search Report was _not prepared_ by EPO or JPO - - - - - - - -  add$1000/$500    +1000    960/961
       2.    Search Report was prepared by EPO or JPO - - - - - - - - - - -  add$860/$430        970/971

SKIP B, C, D AND E UNLESS country code letters in item 1 are "US","BR","BB","TT","MX","IL", "NZ", "IN" or "ZA"    ↓

➔    ☐    B.    If USPTO did not issue _both_ International Search Report    add$970/$485    +0    960/961
(X)            (ISR) _and_ (if box 4(b) above is X'd) the International
               Examination Report (IPER), - - - - - - - - - - - - - - - - - -

(only)
(one) ☐    C.    If USPTO issued ISR but not IPER (or box 4(a) above is
(of)           X'd), - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -    add$710/$355    +0    958/959

(these)
( 4) ➔   ☐    D.    If USPTO issued IPER but IPER Sec. V boxes _not all_ 3    add$690/$345    +0    956/957
(boxes)        YES, - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

➔    ☐    E.    If international preliminary examination fee was paid to    962/963
               USPTO _and_ Rules 492(a)(4) and 496(b) _satisfied_ (IPER
               Sec. V _all_ 3 boxes YES for _all_ claims), - - - - - - - - - - - -    add $100/$50    +0

27.                                                                SUBTOTAL =    $1000

28.    If Assignment box 19 above is X'd, add Assignment Recording fee of ----$40    +40    (581)

29.    Attached is a check to cover the - - - - - - - - - - - - - - - - - - - - - - -    TOTAL FEES    $1040

       Our Deposit Account No. 03-3975
       Our Order No.    60258          |    274039
                              C#        |              M#

                                       Pillsbury Madison & Sutro LLP
                                       Intellectual Property Group

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Atty/Sec: RCI/mhn

                **NOTE:** File in _duplicate_ with 2 postcard receipts (PAT-103) & attachments.

# DETECTION OF INTERFERING SIGNAL IN RADIO RECEIVER

## BACKGROUND OF THE INVENTION

The invention relates to a method of detecting an interfering signal in a time division multiple access (TDMA) radio receiver.

5    When information is transferred over a radio channel, a signal to be transmitted has to be modulated. In modulation, the aim is to obtain a signal of a form which can be transmitted at a radio frequency. The prerequisite of a good modulation method is, for example, that it enables maximum amount of information to be transferred in a narrowest possible frequency band. De-

10    pending on the purpose of use, other features may also be stressed. Furthermore, modulation must not generate more than a minimum amount of interference to a neighbouring channel.

One of the modulation methods is called $\pi/4$-DQPSK ($\pi/4$-shifted, Differential Quaternary Phase Shift Keying) modulation. This modulation

15    method comprises eight phase states, but only four phase shifts. The accepted phase shifts (symbols) are $\pm\pi/4$ and $\pm3\pi/4$. Figure 3A shows a modulation constellation diagram. Each phase shift corresponds to two bits that are to be transmitted. In other words, a digital signal modulates a carrier in two-bit sequences in such a way that a given phase shift corresponds to each two-bit

20    combination during each symbol sequence. A symbol sequence refers here to a signal sequence which is used for transmitting the two bits. The phase shifts, which correspond to bit combinations 00, 01, 10 and 11, are $\pi/4$, $3\pi/4$, $-\pi/4$ and $-3\pi/4$. The symbol frequency used by the Terrestrial Trunked Radio system (TETRA), for example, is 18 kHz and, consequently, the bit frequency is

25    36 kHz.

When a signal is received it has to be demodulated, i.e. the bits which are modulated to the signal have to be detected by a detector so as to find out the information included therein. In transmission over a radio path, an interfering signal may sometimes appear at the frequency used, which inter-

30    fering signal uses a different modulation method from the one used by the actual signal. In the TETRA system, for example, such an interfering signal can be detected by examining the training sequence, which is always included in a timeslot, of the received timeslot. When the bit error ratio of the training sequence is calculated by comparing the training sequence with the stored ver-

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sion of the training sequence and the bit error ratio exceeds a given threshold value, then the received signal is found out to be an interfering signal.

A problem in the above arrangement is that factors, such as strong signal fading, which degrade the quality of reception may occur during the
5    training sequence of the actual signal. The number of bit errors may then become so large that an interfering signal is mistakenly thought to exist.

BRIEF DESCRIPTION OF THE INVENTION

An object of the invention is thus to provide a method so as to solve the above problems. The objectives of the invention are achieved by a method
10   which is characterized by in the method taking samples from symbol sequences of a received signal over a TDMA timeslot, generating by a modulation detector a signal path corresponding to the TDMA timeslot or a portion thereof, determining an error estimate representing the erroneousness of the signal path generated, comparing the error estimate with a predetermined
15   threshold value, and recognizing the reception of the interfering signal if the error estimate is greater than the predetermined threshold value.

The invention is based on the idea of determining an error estimate which represents the erroneousness of a signal path which corresponds to a TDMA timeslot, or a portion of the TDMA timeslot, of the received signal. The
20   error estimate is compared with a predetermined threshold value, and on the basis thereof it is detected whether the received signal is an interfering signal.

It is an advantage of the method of the invention that when a half timeslot, for example, is used as a detection interval, an interfering signal can be detected more reliably than it would be done only on the basis of the train-
25   ing sequence. Furthermore, an error estimate possibly generated in connection with the normal signal detection can be used as an error estimate, enabling an extremely simple implementation.

The invention also relates to equipment for detecting an interfering signal in a time division multiple access (TDMA) radio receiver, whereby the
30   equipment is characterized in that the equipment comprises means for taking samples from symbol sequences of a received signal over a TDMA timeslot and a modulation detector for generating a signal path corresponding to the TDMA timeslot or a portion thereof, and that the equipment is arranged to determine an error estimate representing the erroneousness of the signal path
35   generated and to compare the error estimate with a predetermined threshold

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value, and that the equipment is also arranged to recognize the reception of the interfering signal if the error estimate is greater than the predetermined threshold value. Such equipment enables the advantages of the method of the invention to be achieved in a simple manner.

5       BRIEF DESCRIPTION OF THE DRAWINGS

In the following, the invention will be described in more detail by means of preferred embodiments with reference to the accompanying drawings, in which:

Figure 1 shows a block diagram of a structure of reception of the
10      TETRA system;

Figure 2 shows a simplified diagram of a frame structure of the TETRA system;

Figure 3A shows a phase shift diagram of π/4-DQPSK modulation;

Figure 3B shows constellation points of π/4-DQPSK modulation;
15      Figure 4 shows a block diagram of an adaptive MLSE detector and channel estimators associated therewith according to an embodiment;

Figure 5 shows a flow diagram of an embodiment of the method of the invention.

DETAILED DESCRIPTION OF THE INVENTION

20      In the following, the invention is described in connection with the TETRA system with no intention to restrict the invention to any specific system or a modulation method.

In the TETRA system, information bits which are obtained from a medium access layer (MAC) of a transmission path are encoded by block
25      coding and convolution coding so as to detect and possibly correct at reception the errors arising in a signal on a radio path. The encoded bits are interleaved in such a way that successive bits are far apart from one another. This facilitates error correction in case an instantaneous error falls on the radio path on the signal to be transmitted. The interleaved bits are mixed by using a
30      given colour code by which the transmissions of different base stations can be recognized. In multiplexing, bits of different logical channels are combined. Thereafter, a burst is generated from the multiplexed bits. A burst is a structure which is transmitted in one time division multiple access (TDMA) timeslot or sub-timeslot. The burst is composed of data bit fields 20 and 22 and a
35      training sequence 21 therebetween in the middle of the burst, as illustrated in

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Figure 2. Differential coding generates modulating symbols from pairs of bits of a burst. A carrier which is modulated by control of symbols is amplified in a transmitter and transmitted onto the radio path.

5        The modulation is the above-described $\pi/4$-DQPSK ($\pi/4$-shifted, Differential Quaternary Phase Shift Keying) modulation. This modulation method comprises eight phase states, but only four phase shifts. The accepted phase shifts (symbols) are $\pm\pi/4$ and $\pm3\pi/4$. In practice, the $\pi/4$-DQPSK constellation thus varies at symbol intervals between two 4-pointed constellations which are illustrated in Figure 3B with four black points (the first constel-

10      lation) and with four white points (the second constellation). When the symbol sequence changes it is only possible to shift from the white point to the black point and from the black point to the white point. Each of these eight constellation points can be presented with numbers 0 to 3, as shown in Figure 3B. The constellation points may shift because of the non-idealities of the radio chan-

15      nel.

        Figure 1 shows a block diagram of a receiver structure of the invention for the TETRA system, for example. Only parts of the transceiver which are essential to the description of the invention are shown. In reception, a signal is obtained from an antenna (not shown), and the signal is first processed

20      by radio-frequency parts. Next, A/D converters (not shown) take samples from an intermediate frequency signal. The samples are supplied to a synchronizing block 11, as illustrated by a signal RF in Figure 1. The synchronizing block 11 searches the obtained samples for a training sequence 21 which belongs to the frame structure. The training sequence enables the synchronizing block to

25      accurately determine the moment of sampling, i.e. positions of all the symbols in a sample stream. The synchronizing block also controls the radio-frequency parts of the receiver in order that the signal which is supplied to the A/D converter would stay at an optimal level. The synchronizing block gives a frame to a channel equalizer and a detector block 12. The channel equalizer corrects

30      the non-idealities caused by the radio path channel, and the detector associated with the channel equalizer detects the information bits. Finally, a logical channel is generated from the frame in framing 13, and the logical channel is forwarded for further processing.

        In order to facilitate the understanding of the invention, an example

35      is described above of a general structure of the transceiver. However, the

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structure of the transceiver may vary without deviating from the present inven-
tion.

In a preferred embodiment of the invention, the detector 12 is a
MLSE detector which is provided with a Viterbi algorithm. In other words, the
5    adaptive MLSE detector comprises a Viterbi detector 41 and at least one
adaptive channel estimator $42_a$ ($a=1...M^V$), as shown in Figure 4. The Viterbi
detector 41 estimates the transmitted sequence from the received sequence $r_n$
by a description created by the channel estimator $42_a$ of an impulse response
of the radio channel. The channel estimator $42_a$ adaptively estimates the im-
10    pulse response of the radio channel by decisions $J_n$ or preliminary decisions
which are made by the Viterbi detector 41. One channel estimate corresponds
to one sequence of the Viterbi detector. It is possible to implement these esti-
mates by one common channel estimator. However, this leads to degraded
tracking ability of the channel estimator. The embodiment presented in Figure
15    4 comprises several parallel channel estimators $42_a$, preferably as many as
there are sequences.

It is typical of the radio path that the signal which is transmitted ar-
rives to the receiver over several paths which each have a specific time delay.
In addition, channel properties change as a function of time. For example,
20    beams that are reflected and delayed on the radio path generate intersymbol
interference (ISI). The frequency response or the impulse response of the
channel may be estimated by a discrete-time filter, i.e. a channel estimator,
whose tap coefficients model the radio channel. The aim is to describe the
state of the radio channel by means of the channel estimate.

25    A channel estimator generally refers in this description to a mecha-
nism which estimates and maintains a description of the complex impulse re-
sponse of the radio channel. A method by which the channel estimate is up-
dated is substantially associated with this mechanism. In the TETRA system, a
least mean square (LMS) algorithm can be used for updating the channel es-
30    timates. In order to ensure that the LMS algorithm is converged before the
start of the actual information bits, the detector 12 has to obtain the best pos-
sible initial estimate of the channel state. This estimate is obtained from the
synchronizing block 11 which calculates a complex cross-correlation between
the training sequence 21 of the received signal and the stored version of the
35    training sequence. The cross-correlation result provides an initial value for the
channel estimate, the initial value indicating the average state of the channel

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during the training sequence. Channel correction and symbol detection begin
not until the training sequence is received. This ensures that the timing of the
symbols can be adjusted as accurately as possible and the initial estimate of
the channel can be generated by symbol synchronization. The channel cor-
5      rection both in the forward direction and in the backward direction takes place
in such a way that after the estimates have been initialized, the detector 12 is
instructed over the training sequence 21 towards the end of the burst or to-
wards the start of the burst, respectively, as shown in Figure 2.

A Viterbi algorithm is a method by which a trellis is searched from a
10     set of signal paths for a signal path which corresponds to the maximum likeli-
hood. In the set of signal paths, one channel estimate preferably corresponds
to one signal path. It is also possible to use an estimate common to all paths,
as already mentioned above. Signal paths refer here to various combinations
of successive modulation symbols. At each search stage for the trellis, $M^L$ se-
15     quences advance in the detector, each sequence comprising a specific path
metric which is based on the Euclidean distance. Reference constellation
points are constructed on the basis of the information which is available on the
current state of the channel, i.e. on the basis of the channel estimate. When
the reference constellation points have been calculated, the difference be-
20     tween the reference point and the received sample can be calculated for each
channel estimate. The channel estimate can be updated by means of this er-
ror. The error metric of a given signal path is calculated by summing up the
error metrics, i.e. quadratic errors, of all the points of the signal path.

Figure 5 shows a flow diagram of an embodiment of the method of
25     the invention. In accordance with the basic idea of the invention, in step 51 an
error estimate is determined which represents the erroneousness of the signal
path which corresponds to the timeslot, or a portion of the timeslot, of a signal
received in step 50. According to the preferred embodiment of the invention,
the error estimate is determined for a half timeslot 20 or 22. Furthermore, ac-
30     cording to the preferred embodiment, as the error estimate is used an error
metric which is generated by the detector 12, in addition to the bits it has de-
tected, to represent in the manner described above the erroneousness of the
bit information the detector has generated. Next, in step 52 the error metric is
compared with a predetermined threshold value. If the error
35     metric value exceeds the threshold value, i.e. if the erroneousness of the sig-
nal for each half timeslot is greater than the predetermined value, then it can

be assumed that the received signal is an interfering signal or a signal other than a TETRA-modulated signal (step 53). The method can be made more reliable by using a detection time period which is longer than a half timeslot.

According to an alternative embodiment of the invention, besides the detector 12, one or more parallel detectors preferably of different types are employed. The parallel detectors operate independently and each of them generate an error metric value of their own for the information they have produced. The detector having the best error metric value is selected from these parallel detectors, and the routine proceeds in accordance with the first preferred embodiment of the invention by comparing the error metric of the selected detector with the predetermined threshold value as described above. When parallel detectors of different types are used, good performance can be achieved by one detector even in reception conditions in which the other detector does not operate optimally. A coherent detector, for example, operates well on a channel which contains noise but does not contain intersymbol interference. Correspondingly, a better performance is achieved by a channel equalizer-type detector on a channel which contains intersymbol interference.

It will be apparent to those skilled in the art that progress in technology enables the basic idea of the invention to be implemented in various ways. The invention and its embodiments are therefore not restricted to the above examples but they may vary within the scope of the claims.

CLAIMS

1. A method of detecting an interfering signal in a time division multiple access (TDMA) radio receiver, **c h a r a c t e r i z e d** by in the method

taking samples from symbol sequences of a received signal over a
5    TDMA timeslot,

generating by a modulation detector a signal path corresponding to the TDMA timeslot or a portion thereof,

determining an error estimate representing the erroneousness of the signal path generated,

10    comparing the error estimate with a predetermined threshold value, and

recognizing the reception of the interfering signal if the error estimate is greater than the predetermined threshold value.

2. A method as claimed in claim 1, **c h a r a c t e r i z e d** by using
15    in the comparison an error estimate of a signal path corresponding to a half timeslot.

3. A method as claimed in claim 1 or 2, **c h a r a c t e r i z e d** by using a signal path error metric which is generated by means of quadratic errors which are calculated on the basis of the difference between individual
20    symbol sequence specific sample points and corresponding reference constellation points constructed on the basis of the channel estimate describing the state of the radio channel used as the error estimate representing the erroneousness of the signal path.

4. A method as claimed in claim 1, 2 or 3, **c h a r a c t e r i z e d** by
25    generating two or more alternative signal paths from the received timeslot or a portion thereof by two or more parallel modulation detectors preferably of different types,

determining an error estimate of each signal path, and

selecting the signal path having the best error estimate to be used
30    in the comparison.

5. Equipment for detecting an interfering signal in a time division multiple access (TDMA) radio receiver, **c h a r a c t e r i z e d** in that the equipment comprises

means for taking samples (50) from symbol sequences of a re-
35    ceived signal over a TDMA timeslot and

a modulation detector (12) for generating a signal path corresponding to the TDMA timeslot (20, 21, 22) or a portion thereof, and that

the equipment is arranged to determine (51) an error estimate representing the erroneousness of the signal path generated and to compare (52)

5 the error estimate with a predetermined threshold value, and that

the equipment is also arranged to recognize (53) the reception of the interfering signal if the error estimate is greater than the predetermined threshold value.

6. Equipment as claimed in claim 5, **c h a r a c t e r i z e d** in that it

10 is arranged to use in the comparison (52) an error estimate of a signal path corresponding to a half timeslot (20 or 22).

7. Equipment as claimed in claim 5 or 6, **c h a r a c t e r i z e d** in that a signal path error metric which is generated by means of quadratic errors calculated on the basis of the difference between individual symbol sequence

15 specific sample points and corresponding reference constellation points constructed on the basis of the channel estimate describing the state of the radio channel used is used as the error estimate representing the erroneousness of the signal path.

8. Equipment as claimed in claim 5, 6 or 7, **c h a r a c t e r i z e d** in

20 that it comprises two or more parallel modulation detectors preferably of different types for generating two or more alternative signal paths from the received timeslot or a portion thereof, the equipment being arranged to determine an error estimate of each signal path and to select the signal path having the best error estimate to be used in the comparison.
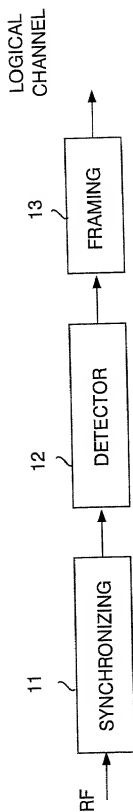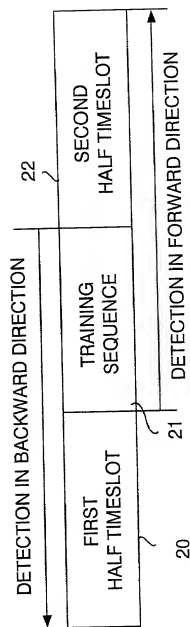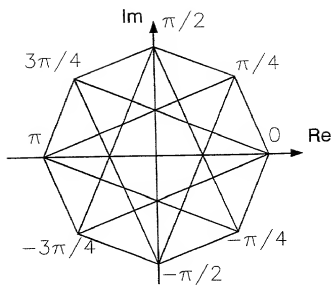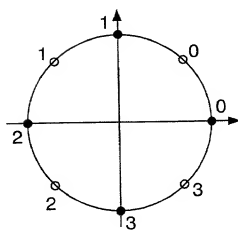
FIG. 1



FIG. 2

FIG. 3A



FIG. 3B

FIG. 4

```
        ┌─────────────┐
        │    START    │
        └─────────────┘
               │
        ┌─────────────┐
        │  TIME SLOT  │ ╲ 50
        │  RECEPTION  │
        └─────────────┘
               │
        ┌─────────────┐
        │  DETERMINE  │ ╲ 51
        │    ERROR    │
        │   ESTIMATE  │
        └─────────────┘
               │
    52 ╲ ╱───────────────╲   NO
      ╱    IS ERROR       ╲─────┐
      ╲ ESTIMATE>THRESHOLD ╱     │
       ╲     VALUE ?      ╱      │
        ╲───────────────╱        │
               │ YES             │
    53 ╲ ┌─────────────┐         │
       │  RECOGNIZE    │         │
       │  INTERFERING  │         │
       │SIGNAL RECEPTION│        │
       └─────────────┘          │
               │◄────────────────┘
        ┌─────────────┐
        │     END     │
        └─────────────┘
```
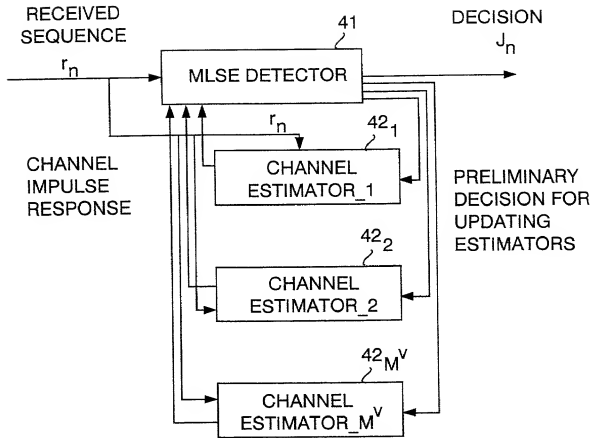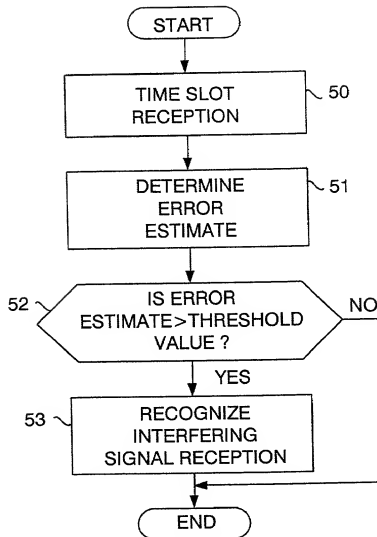
FIG. 5

FOR UTILITY/DESIGN      RULE 63 (37 C.F.R. 1.63)      PM & S
CIP/PCT NATIONAL/PLANT      DECLARATION AND POWER OF ATTORNEY      FORM
ORIGINAL/SUBSTITUTE/SUPPLEMENTAL      FOR PATENT APPLICATION
DECLARATIONS      IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

As a below named inventor, I hereby declare that my residence, post office address and citizenship are as stated below next to my name, and I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the **INVENTION ENTITLED** _____
Detection of interfering signal in radio receiver

the specification of which (CHECK applicable BOX(ES) )

X      → A. ☐ is attached hereto.
BOX(ES)    → B. ☐ was filed on _____ as U.S. Application No. _____ / _____
       → C. ☒ was filed as PCT International Application No. PCT/ F199 / 00443 on 24 May 1999

and (if applicable to U.S. or PCT application) was amended on _____

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose all information known to me to be material to patentability as defined in 37 C.F.R. 1.56. I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT International Application which designated at least one other country than the United States, listed below and have also identified below any foreign application for patent or inventor's certificate, or PCT International Application, filed by me or my assignee disclosing the subject matter claimed in this application and having a filing date (1) before that of the application on which priority is claimed, or (2) if no priority claimed, before the filing date of this application:

**PRIOR FOREIGN APPLICATION(S)**

| Number | Country | Day/MONTH/Year Filed | Date first Laid-open or Published | Date Patented or Granted | Priority Claimed Yes | No |
|---|---|---|---|---|---|---|
| 981152 | FI | 25 May 1998 | | | | X |

I hereby claim domestic priority benefit under 35 U.S.C. 119(e) or 120 and 365(c) of the indicated United States applications listed below and PCT International applications listed above or below and, if this is a continuation-in-part (CIP ) application, insofar as the subject matter disclosed and claimed in this application is in addition to that disclosed in such prior applications, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in 37 C.F.R. 1.56 which became available between the filing date of each such prior application and the national or PCT international filing date of this application:

**PRIOR U.S. PROVISIONAL, NONPROVISIONAL AND/OR PCT APPLICATION(S)**

| Application No. (series code/serial no.) | Day/MONTH/Year Filed | Status pending, abandoned, patented | Priority Claimed Yes | No |
|---|---|---|---|---|
| | | | | |

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

And I hereby appoint Pillsbury Madison & Sutro LLP, Intellectual Property Group, 1100 New York Avenue, N.W., Ninth Floor, East Tower, Washington, D.C. 20005-3918, telephone number (202) 861-3000 (to whom all communications are to be directed), and the below-named persons (all of the same address) individually and collectively my attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith and with the resulting patent, and I hereby authorize them to delete names/numbers below of persons no longer with their firm and to act and rely on instructions from and communicate directly with the person/assignee/attorney/firm/ organization who/which first sends/sent this case to them and by whom/which I hereby declare that I have consented after full disclosure to be represented unless/until I instruct the above Firm and/or a below attorney in writing to the contrary.

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(FOR ADDITIONAL INVENTORS, check box ☐ to attach PAT 116-2 same information for each re signature, name, date, citizenship, residence and address.)